Short Report POSEIDON Cruise 438

4D- observation of hydro-dynamical, chemical, and biological properties and its influence on cold-water coral growth in the Stjernsund, Norway

Tromsø - Tromsø - Kiel
10. Sept. – 27. Sept. 2012

Cruise lead
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I. Objectives

POSEIDON cruise 438 was the follow up cruise of Poseidon 434 (May/June 2012) to one of the northernmost European cold-water coral reefs in the Stjernsund (North Norway). Our aim is to investigate the environmental boundary conditions of recent cold-water coral ecosystem functioning (growth and distribution pattern). Overarching objective was to look at potential reef effects and feedbacks of cold-water coral reefs and the ambient water masses in a 4D-observation mode employing a novel long-term observatory "MoLab" for meso-scale (~5 km x 3 km) investigations.

The study area is an ideal test bed to address these objectives since the Stjernsund reef is characterized by healthy living corals and rich associated fauna while the oceanographic setting is limited to a NW-SE trending passage with dominating flow from the NW. Additionally, the reef displays all structures/zones which are known for this type of ecosystem such as normal sund/fjord trough sediments, coral rubble, as well as living and dead corals. The MoLab observatory array measures physical, biogeochemical, and hydro-chemical parameters in 4D resolution.

During cruise POSEIDON 434 we deployed the MoLab observatory to measures timely synchronized physical, chemical, and biogeochemical parameters for a period of ca. 105 days. During cruise POSEIDON 438 we retrieved the MoLab array and made some additional short deployments of a MoLab Eddy Correlation Module. We further made a series of photography transects with the ROV in hitherto uninvestigated regions of the sill.

The comprehensive data set gained will be used as the basis for various types of numerical models which improve our understanding of oceanographic-biological interaction. The combination of high quality data sets and numerical models will further facilitate our knowledge of future coral reef development under prognosticated global change in Arctic environments.

The MoLab observatory comprises of the following components and sensors:

<u>2x Moorings (VKM and VKM+SYK) equipped with:</u>

- temperature/salinity logger
- dissolved oxygen sensor
- ADCP
- optical turbidity logger
- chlorophyll

One VKM is equipped with a synchronization HAM-knot (SYK) which allows timely synchronized measurements.

1x Master Lander (MLM) equipped with:

- ADCP (300 kHz)
- ADCP (1200 kHz)
- CTD
- 4 dissolved oxygen sensor
- sediment trap
- digital time lapse camera system
- pH sensor
- chlorophyll
- turbidity

3x Satellite Lander (SLM) equipped with:

- ADCP
- CTD
- fluorometer
- optical turbidity logger
- dissolved oxygen sensor
- pH sensor
- chlorophyll
- turbidity

3x Eddy Correlation Module (ECM):

- eddy flux sensor

The work-class ROV "PHOCA" was employed for site surveys (habitat and facies mapping), sampling and deployment/re-arrangement of instruments and modules.

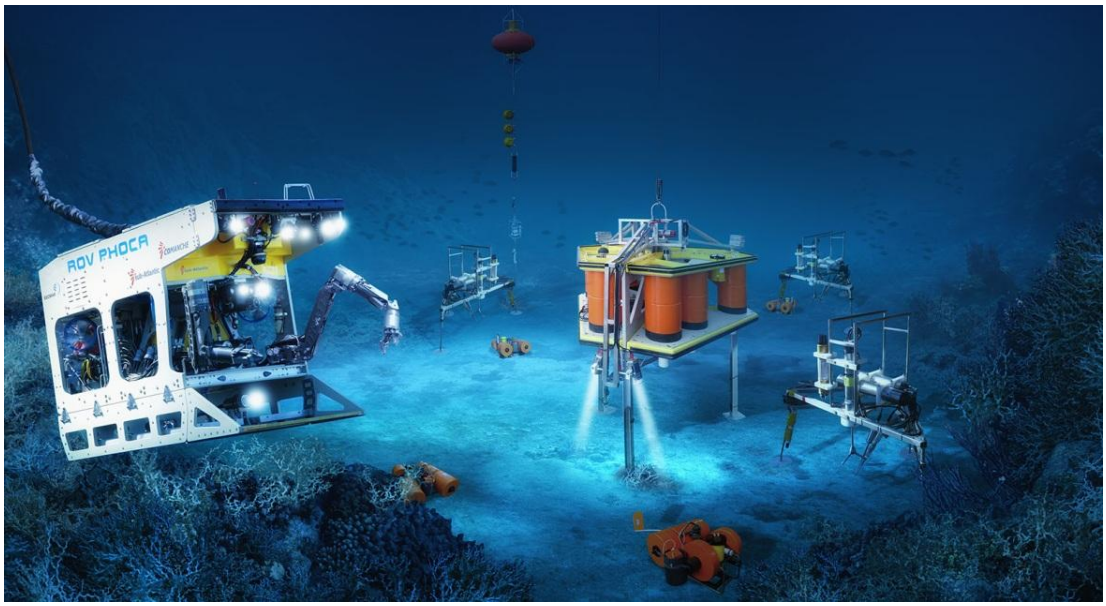

Figure 1: An artist`s impression of the MoLab observatory with the MLM surrounded by ECMs, SLMs and a VKM in the background.

II. Area of investigation

The Stjernsund is a NW-SE trending passage between the Norwegian Sea (Lopphavet) and the Altafjord (Fig. 2). The passage is limited to the North by the island Stjernøya and the by Norwegian mainland to the South. The working area is arranged by a rectangle following the shape of the Stjernsund (Fig. 2). The length of the sound is approximately 10 nm which implied only short steaming distances between individual stations. The center of activity was located in the middle of the passage at a sill with bearing a rich reef structure which divides the sound into two basins, here called western and eastern basin facing the Norwegian Sea respectively the Alta Fjord. Maximum depths of the basins are 500 m. The deployment area of the MoLab observatory stretched about 3 nm x 2 nm with the sill/reef in the center (Fig. 3). The main reef is NNE-SSW oriented and located about 25 m below the sill crest at about 225 m water depth.

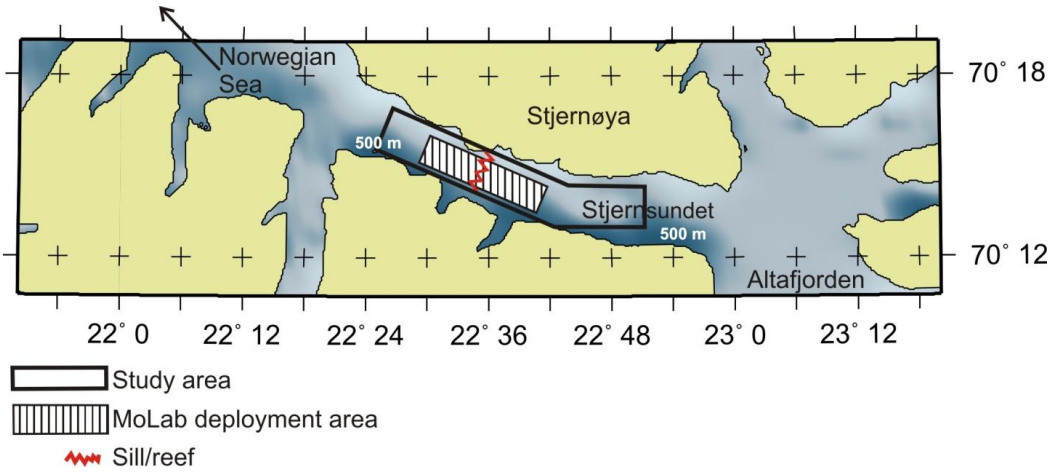

Figure 2: The Stjernsund with the study area.

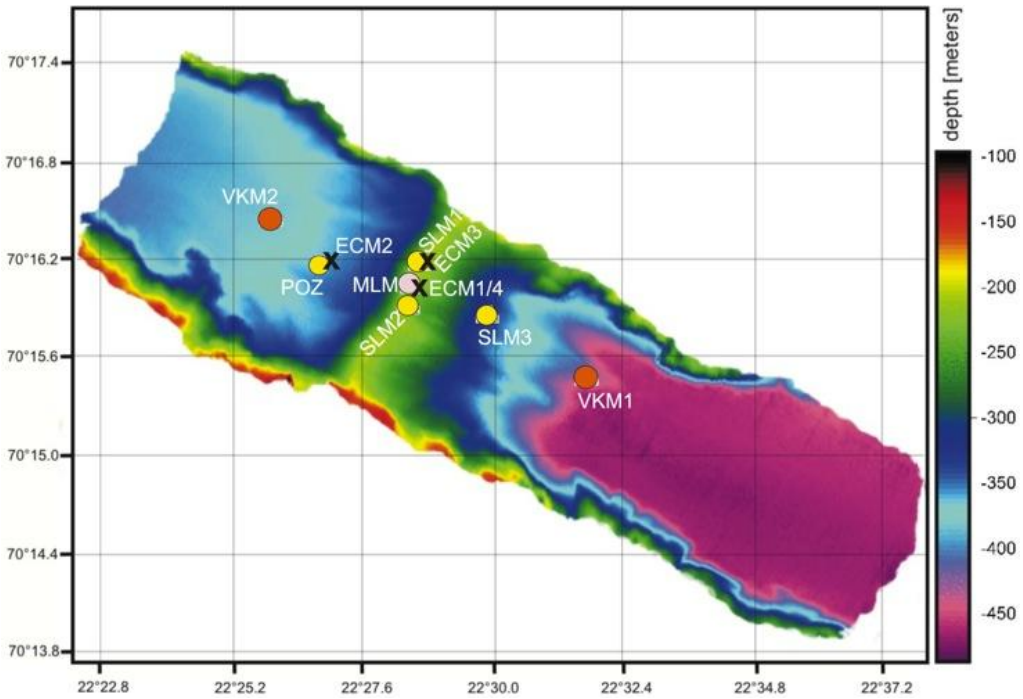

Figure. 3: Bathymetric map of the study area with the deployment positions of the MoLab array.

III. Participants

	Name		Task	Institution
1.	Pfannkuche	Olaf	Cruise lead	GEOMAR
2.	Bodendorfer	Matthias	ROV-Technician	GEOMAR
3.	Bryant	Lee	Scientist	GEOMAR
4.	Cuno	Patrick	ROV-Technician	GEOMAR
5.	Fabricius	Eduard	Technician	GEOMAR
6.	Flögel	Sascha	Scientist	GEOMAR
7.	Hennke	Jan	ROV-Technician	GEOMAR
8.	Linke	Peter	Scientist	GEOMAR
9.	Nicolai	Maike	Public relation	GEOMAR
10.	Petersen	Asmus	Technician	GEOMAR
11.	Pieper	Martin	ROV-Technician	GEOMAR
12.	Wilson	Mark	ROV-Technician	sub-Atl.

IV. Participating Institutions

GEOMAR: Helmholtz-Zentrum für Meeresforschung, Wischhofstr. 1-3, 24148 Kiel, Germany.

sub-Atl.: sub-Atlantic, Aberdeen, UK.

V. Narrative of the cruise

Monday, 10. 09. 12: The scientific equipment arrived on two trucks from Kiel at 13:00h in Tromsø harbor and was loaded immediately on the ship during the afternoon. We started with the installation of the ROV system.

Tuesday, 11. 09. 12: We continued with the setup of the 3000m rated GEOMAR work class ROV "PHOCA". In the afternoon we performed a short test of the ROV in the harbor basin. We left Tromsø at 17:00h and headed to the open Norwegian Sea through the Malangen Fjord.

Wednesday, 12.09.12: We reached the position 69° 42,4´N / 15° 28,5´E at 08:00h where we performed a ROV- winch test by 2120m. Afterwards we continued our passage to the Stjernsund.

Thursday, 13.09.12: We reached our first working station in the Stjernsund and started with a CTD/RO cast by 364m (Stat. 423). This action was followed by an ROV deployment at 367m (Stat 424). In the afternoon we recovered the first satellite lander (SLM#3, Stat. 425) from the western slope of the sill.

Friday, 14.09.12: The day started with a ROV-survey on the western slope of the sill (Stat. 426). During the late morning we recovered the first mooring of 350m length (VKM#2, Stat. 427) from the western basin. In the afternoon we deployed a new eddy correlation module (ECM#4) with the ROV on the crest of the sill in a rich coral occurrence (Stat. 428).

Saturday, 15.09.2012: Our first action was the recovery of the second oceanographic mooring (VKM#1) from the eastern basin (Stat. 429). Afterward we steamed to the western crest region of the sill where we recovered ECM#3 with the ROV (Stat. 430). Next we recovered two satellite landers SLM#2 and SLM#1 from the top region of the sill (Stat 431-32) which was followed by a CTD/RO cast (Stat. 433) by 210m.

Sunday, 16.09.2012: The morning was dedicated to a ROV photographic survey of the northern sill region at the slope of Stjernøya (Stat. 434). Afterwards the ship changed position to the mid of the sund where we recovered the ECM#4 with the ROV PHOCA (Stat. 435).

Monday, 17.09.2012: The first action in the morning was the redeployment of ECM#4 with the ROV on the top region of the sill (Stat. 436). Next came the recovery of ECM#1 (Stat. 437). In the afternoon we recovered the MLM from the crest of the sill (Stat. 438). The rest of the working day was spent testing the ROV in shallow water by 65m water depth (Stat. 439).

Tuesday, 18.09.2012: We started the day with a CTD/Ro cast on the top of the sill (Stat. 440). Afterwards we launched the ROV for a longer photographic transect acrossthe eastern flank of the sill (Stat. 441). Afterwards the ROV was employed again to recover ECM#4 (Stat. 442). With this action all instruments deployed on the seabed either from cruise Poseidon 434 or from this cruise were taken up again. After a final CTD/RO cast (Stat. 443) we stopped our scientific work in the Stjernsund. POSEIDON left the Stjernsund site in the late afternoon and took course to Tromsø.

Wednesday, 19.09.2012: We arrived at Tromsø harbour in the morning and moored after a short stop at the bunker station at the passenger terminal where we stayed until next morning. A part of the scientific crew was disembarked to fly back home.
Thursday, 20.09.2012: At 08:00 we cast off at Tromsö and started our journey home to Kiel. We steamed through the inner fjord passage and entered the open sea at the mouth of the Vestfjord (Lofot Islands).
Friday, 21.09. – Wednesday, 26.09.2012: We continued our home journey by steaming through the Norwegian Sea, North Sea, Skagerrak and Kattegat.
Thursday, 27.09.2012: POSEIDON arrived at the GEOMAR east shore pier at 09:00h in the morning and with discharge of the ship Cruise POS 438 ended.

VI. Equipment used and gear abbreviations

CTD/RO: CTD/Rosette water sampler
ECM#1: Eddy Correlation Module 1
ECM#2: Eddy Correlation Module 2
ECM#3: Eddy Correlation Module 3
ECM#4: Eddy Correlation Module 4
MLM: Master Lander
ROV: Remotely Operated Vehicle
SLM#1: Satellite Lander 1
SLM#2: Satellite Lander 2
SLM#3: Satellite Lander 3
VKM#1-HAM: Oceanographic Mooring with HAM-Node (350m length).
VKM#2: Oceanographic Mooring (350m length)

VII. List of sampling Stations

See over leaf in Table 1.

Table 1: Station list POSEIDON 438

Station	Gear	Date	Time	Coordi	nates 1	Depth	Coordi	nates 2	Depth	Time
POS438		2012	(UTC)	Lat. °N	Long. °E	(m)	Lat. °N	Long. °E	(m)	(UTC)
423	CTD/RO-1	13.09.	06:30	70° 16,222	22° 26,858	364				
424	ROV-1	13.09.	07:52	70° 16,272	22° 26,178	367	70° 16,215	22° 26,895	362	08:35
425	SLM#3 Recovery	13.09.	15:15	70° 15,971	22° 29,792					
426	ROV-2	14.09.	07:11	70° 16,241	22° 26,759	367	70° 16,216	22° 26,888	364	09:28
427	VKM#2 Recovery	14.09.	11:00	70° 16,254	22° 26,906					
428	ECM#4 Depl./ROV-3	14.09.	13:51	70° 16,067	22° 28,524	218				
429	VKM#1 Recovery	15.09.	05:58	70° 15,850	22° 29,458					
430	ECM#3 Recov./ROV-3	15.09.	08:10	70° 16,256	22° 28,321	304	70° 16,207	22° 28,678	218	09:57
431	SLM#2 Recovery	15.09.	11:10	70° 15,948	22° 28,485					
432	SLM#1 Recovery	15.09.	11:30	70° 15,840	22° 28,555					
433	CTD/RO-2	15.09.	12:15	70° 16,079	22° 28,522	210				
434	ROV-5	16.09.	07:29	70° 16,510	22° 28,711	309	70° 16,630	22° 29,816	46	09:55
435	ECM#4 Recov./ROV-6	16.09.	12:59	70° 16,112	22° 28,241	260	70° 16,074	22° 28,504	219	14:02
436	ECM#4 Depl./ROV-7	17.09.	09:00	70° 16,507	22° 28,999	270				
437	ECM#1 Recov./ROV-8	17.09.	10:36	70° 16,065	22° 28,542	220	70° 16,070	22° 28,517	217	11:12
438	MLM Recovery	17.09.	12:01	70° 15,990	22° 28,800					
439	ROV-9	17.09.	14:20	70° 13,030	22° 37,370	65				
440	CTD/RO-3	18.09.	06:00	70° 16,084	22° 28,518	206				
441	ROV-10	18.09.	07:23	70° 15,879	22° 27,251	340	70° 16,006	22° 28,553	270	11:32
442	ECM#4 Recov./ROV-11	18.09.	13:35	70° 16,517	22° 28,922	306	70° 16,509	22° 29,033	268	14:15
443	CTD/RO-4	18.09.	15:10	70° 15,737	22° 30,261	361				